Interrater Reliability of Palpation of Myofascial Trigger Points in Three Shoulder Muscles

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Abstract: This observational study included both asymptomatic subjects (n=8) and patients with unilateral or bilateral shoulder pain (n=32). Patient diagnoses provided by the referring medical physicians included subacromial impingement, rotator cuff disease, tendonitis, tendinopathy, and chronic subdeltoid-subacromial bursitis. Three raters bilaterally palpated the infraspinatus, the anterior deltoid, and the biceps brachii muscles for clinical characteristics of a total of 12 myofascial trigger points (MTrPs) as described by Simons et al. The raters were blinded to whether the shoulder of the subject was painful. In this study, the most reliable features of trigger points were the referred pain sensation and the jump sign. Percentage of pair-wise agreement (PA) was ≥ 70% (range 63–93%) in all but 3 instances for the referred pain sensation. For the jump sign, PA was ≥ 70% (range 67–77%) in 21 instances. Finding a nodule in a taut band (PA = 45–90%) and eliciting a local twitch response (PA = 33–100%) were shown to be least reliable. The best agreement about the presence or absence of MTrPs was found for the infraspinatus muscle (PA = 69–80%). This study provides preliminary evidence that MTrP palpation is a reliable and, therefore, potentially useful diagnostic tool in the diagnosis of myofascial pain in patients with non-traumatic shoulder pain.

Key Words: Myofascial Pain Syndrome, Myofascial Trigger Points, Interrater Reliability, Palpation, Shoulder Pain

Shoulder complaints are very common in modern industrial countries. Recent reviews[1-4] have indicated a one-year prevalence ranging from 4.7 to 46.7%. These reviews have also reported a lifetime prevalence between 6.7 and 66.7%. This wide variation in reported prevalence can be explained by the different definitions used for shoulder complaints and by differences in the age and other characteristics of the various study populations. Because making a specific structure-based diagnosis for patients with shoulder complaints is considered difficult due to the lack of reliable tests for shoulder examination, recent guidelines developed by the Dutch Society of General Practitioners have recommended instead using the term "shoulder complaints" as a working diagnosis[5]. Shoulder complaints have been defined in a similarly non-specific manner as signs and symptoms of pain in the deltoid and upper arm region, and stiffness and restricted movements of the shoulder, often accompanied by limitations in daily activities[6].

Despite the absence of reliable diagnostic tests to implicate these structures, the currently prevailing assumption is that in non-traumatic shoulder complaints, mostly the anatomical structures in the subacromial space are involved, i.e., the subacromial bursa, the rotator cuff tendons, and the tendon of the long head of the biceps muscle[7-9]. However, this assumption does not take into account that muscle tissue itself can also give rise to pain in the shoulder region[10]. In our clinical experience, myofascial trigger points (MTrPs) may lead to myofascial pain in the shoulder and upper arm region and contribute to the burden of shoulder complaints.

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The term *myofascial pain* was first introduced by Travell[10], who described it as "the complex of sensory, motor, and autonomic symptoms caused by myofascial trigger points." An MTrP is a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. In addition, the spot is painful on compression and may produce characteristic referred pain, referred tenderness, motor dysfunction, and autonomic phenomena. Two different types of MTrPs have been described: active and latent. Active trigger points are associated with spontaneous complaints of pain. In contrast, latent trigger points do not cause spontaneous pain, but pain may be elicited with manual pressure or with needling of the trigger point. Despite not being spontaneously painful, latent MTrPs have been hypothesized to restrict range of motion[11] and to alter motor recruitment patterns[12].

As noted above, referred pain is a key characteristic of myofascial pain. Referred pain is felt remote from the site of origin[13]. The area of referred pain may be discontinuous from the site of local pain or it can be segmentally related to the lesion, both of which may pose a serious problem for the correct diagnosis and subsequent appropriate treatment of muscle-related pain. The theoretical model for this phenomenon of referred pain was first proposed by Ruch[14] and later modified by Mense[13-15] and Hoheisel[14]. Referred pain patterns originating in muscles have been documented using injection of hypertonic saline, electrical stimulation, or pressure on the most sensitive spot in the muscle[17-21]. In the clinical setting, palpation is the only method capable of diagnosing myofascial pain. Therefore, reliable MTrP palpation is the necessary prerequisite for considering myofascial pain as a valid diagnosis[22]. Published interrater studies have reported poor to good reliability for MTrP palpation[23-29]. However, only one study has included a muscle that could produce shoulder pain: Gerwin et al[27] reported a percent agreement (PA) of 83% for tenderness in the infraspinatus muscle (κ=0.48), 83% (κ=0.40) for the taut band, 59% (κ=0.17) for the local twitch response, and 89% (κ=0.84) for the referred pain.

In light of this near absence of data, of the societal impact of shoulder complaints as noted above, and of the potential role of myofascial pain syndrome with regard to shoulder pain, the aim of this study was to determine the interrater reliability of MTrP palpation in three human shoulder muscles deemed by us to be clinically relevant, i.e., the infraspinatus, the anterior deltoid, and the biceps brachii muscles.

Methods and Materials

Subjects

Subjects were recruited from a consecutive sample of patients with unilateral or bilateral shoulder pain referred by their physician to a physical therapy private practice specializing in the management of persons with neck, shoulder, and upper extremity musculoskeletal disorders. To decrease limited variation within the data set and to control for rater bias, we also included asymptomatic subjects.

All subjects were unacquainted with and had not met the raters. Additional inclusion criteria for participation in the study were age between 18 and 75 years and the ability to read and understand the Dutch language. Exclusion criteria were known serious rheumatological, neurological, orthopaedic, or internal diseases, such as adhesive capsulitis, rotator cuff tears, cervical radiculopathy, diabetes mellitus, recent shoulder or neck trauma, or shoulder/upper extremity complaints of uncertain origin as diagnosed by the referring physicians. After reading a brief synopsis of the aim of the study and the test procedure, all subjects signed an informed consent form. The Committee on Research involving Human Subjects of the district Arnhem-Nijmegen approved the study design, the protocols, and the informed consent procedure.

Raters and Observers

The raters were three physical therapists: rater A with 29, rater B with 28, and rater C with 16 years of clinical experience, respectively. All were employed at the private practice where this study was conducted. The raters had all specialized in the diagnosis and management of patients with musculoskeletal disorders of the neck, shoulder, and upper extremity; and they had 21, 16, and 2 years of experience, respectively, with regard to diagnosis and management of MTrPs.

The observers were three physical therapists who also had experience in treating patients with myofascial pain. Prior to the study, they were informed by the lead investigator (CB) about the study protocol, and they participated in the training sessions with the raters.

Both raters and observers participated in a total of eight hours of training. During these sessions, they were able to practice their skills, to compare with each other, and to discuss palpation technique, subject positioning, the amount of pressure used by the examiners[30], and the location of the MTrPs (Figure 1). Before proceeding with the study, they reached consensus about all aspects of the examination.

Trigger Point Examination

Simons et al[31] documented 11 muscles in total that could refer pain to the frontal or lateral region of the shoulder and arm (Table 1). Based on our clinical observation that these muscles are frequently involved in patients with shoulder pain, we chose to study the infraspinatus, the anterior deltoid, and the biceps brachii. Without providing specific data on prevalence, Simons et al[31] reported that the infraspinatus is very often involved in shoulder pain. Hong[32] noted that the

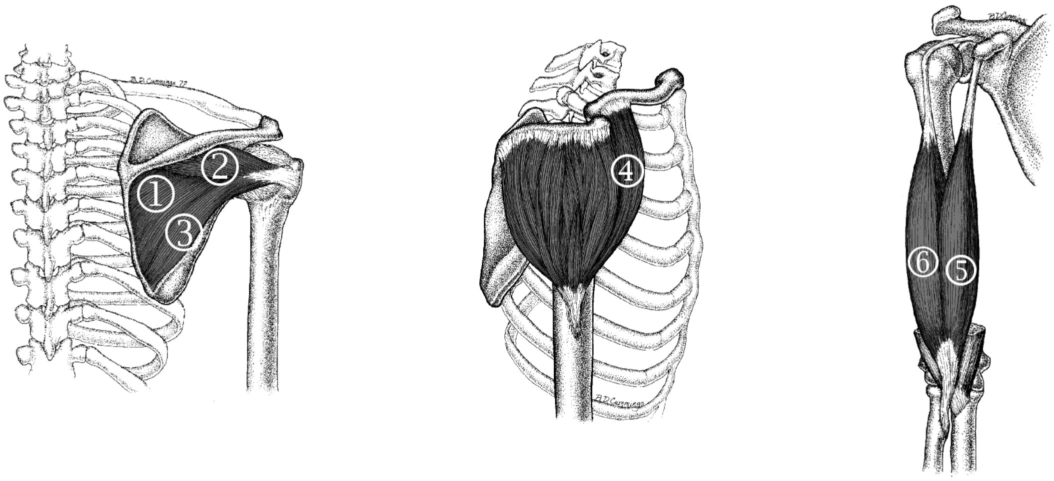


Fig 1. The localization of trigger points in the infraspinatus muscle, biceps brachii, and the anterior deltoid muscles The numbers correspond with the sequence of palpation during the test.

Illustrations courtesy of Lifeart/Mediclip, Manual Medicine 1, Version 1.0a, Williams & Wilkins, 1997.

deltoid and the biceps brachii could give rise to satellite MTrPs of the infraspinatus muscle. Hsieh[33] provided evidence for the existence of a key-satellite relation between the infraspinatus muscle and the anterior deltoid muscle. A satellite trigger point may develop in the referral zone of a key MTrP located in the key muscle. It may also develop in an overloaded synergist that is substituting for the muscle that is harboring the key MTrP, in an antagonist countering the increased tension of the key muscle, or in a muscle that is linked apparently only neurogenically to the key MTrP. Sometimes this hierarchy is obvious but it is not always evident. Key and satellite trigger points are related to each other; our clinical observations indicate that signs and symptoms related to satellite trigger points diminish when key MTrPs are treated appropriately.

TABLE 1. Muscles with a known referred pain pattern to the frontal or lateral region of the shoulder and/or arm [31]

Muscle
Infraspinatus
Deltoid [anterior and middle part]
Biceps brachii
Supraspinatus
Coracobrachialis
Lattisimus dorsi
Scalene
Pectoralis major
Pectoralis minor
Subclavius
Sternalis

Another reason for our choice of these specific muscles is that all three muscles studied here are part of the same functional unit with all three muscles acting as synergists active during shoulder flexion. Although the infraspinatus muscle is traditionally known as an external rotator, this is only true for the anatomical position. This muscle is one of the rotator cuff muscles that is active during flexion of the upper arm to provide stability of the glenohumeral joint during arm movements[34,35].

Although MTrPs may be found anywhere in the muscle belly, we agreed to palpate for their presence only in close proximity to the motor endplate zones. The reason for this choice of location is that Simons et al[31] have suggested that the primary abnormality responsible for MTrP formation is associated with individual dysfunctional endplates in the endplate zone or motor point.

We bilaterally palpated these three muscles for MTrPs using four of the criteria proposed for the palpatory diagnosis of MTrPs[31]:

1. Presence of a taut band with a nodule. The rater examined the subject by palpating the muscle perpendicular to the muscle fiber orientation with either a flat palpation (infraspinatus muscle and the anterior deltoid muscle) or a pincer palpation (biceps brachii muscle). When a taut band was identified, the rater palpated along the taut band to locate the nodule. The raters were asked to search for multiple MTrPs in each muscle. The palpatory findings were more important than the exact location of the MTrPs as indicated by Simons et al[31].

2. Reported painful sensation during compression in an area consistent with the established referred pain pattern of the involved muscle. While compressing the palpable nodule in the taut band, the subject was asked if he or she felt any pain or any sensation (e.g., tingling or numbness) in an area remote from the compressed point. When the subjects reported referred sensation, they were asked to describe this area. The rater then decided whether this area was comparable to the established referred pain zone (Figure 2).
3. Presence of a visible or palpable local twitch response (LTR) during snapping palpation. The rater quickly rolled the taut band under the fingertip, while examining the skin above the muscle fibers for this characteristic short and rapid movement.
4. Presence of a general pain response during palpation, also known as a jump sign. While compressing the MTrP, the rater carefully examined the subject's reaction. A positive jump sign was defined as the subject withdrawing from palpation, wincing, or producing any pain-related vocalization.

All four criteria were scored dichotomously:

- Yes if the rater was certain of presence of a parameter
- No if the rater was sure of the absence of a parameter or if the rater was unsure of presence or absence

Examination of the infraspinatus muscle was performed with the subjects seated with the arms hanging down by the side of the body. Examination of the anterior deltoid and biceps brachii muscles was performed with the forearms supported with slight elbow flexion (Figure 3).

The raters were blinded to subject status; i.e., the subjects were not allowed to indicate whether they were symptomatic. They were instructed to inform the raters when they felt pain somewhere else than the palpation site or when they experienced a referred sensation. However, they were not allowed to tell the rater whether they felt a recognizable pain because that would negate attempts at rater blinding.

In addition to scoring the separate criteria, the raters were asked to judge whether a trigger point was present or absent. Simons et al[31] suggested that minimal diagnostic criteria for an MTrP consist of a palpable nodule present in a palpable taut band. Simons et al also required that this produce the patient's recognizable pain upon compression, but we should note that in this study, the subjects were not allowed to inform the examiners of their symptom status. Therefore, in this study the examiners decided that the MTrP was present when the palpable nodule in the taut band was present together with at least one or more of the other clinical characteristics. In all other combinations, it was said that the MTrP was absent. As a result of this study design, no distinction was made between active and latent MTrPs, as the examiners were not allowed to inquire whether subjects recognized the pain from palpation. Therefore, examiners may have reported on both active and latent MTrPs in symptomatic and asymptomatic subjects.

Methods

During two morning sessions separated by a one-week interval, two different groups of 20 subjects each were examined. The raters completed the assessment of each of the four

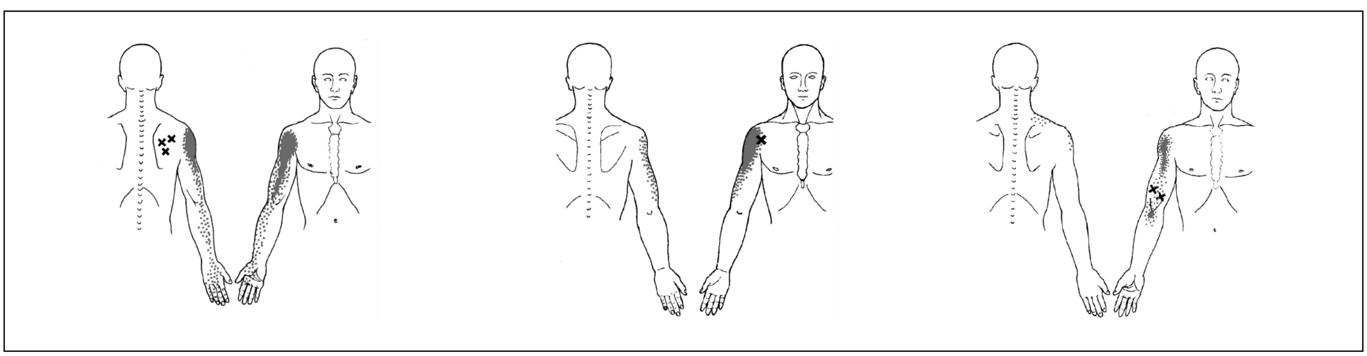
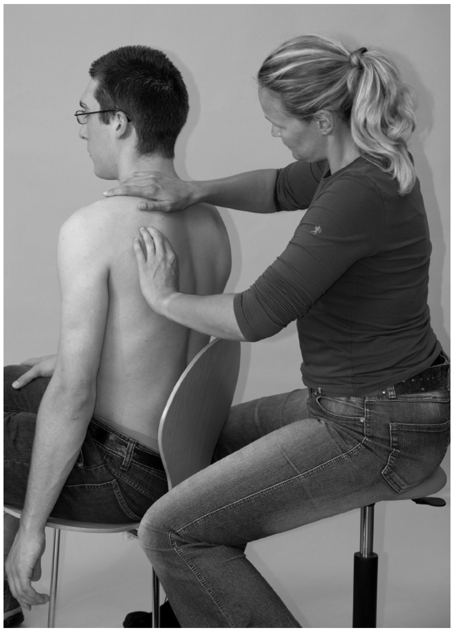


Fig. 2. The localization of trigger points in the infraspinatus, biceps brachii and the anterior deltoid muscle and the referred pain patterns according to Simons et al[31].

X = trigger point

Solid gray shows the essential referred pain zone, nearly present in all patients, while the stippling represents the spillover zone, present in some but not all patients[31].

Illustrations courtesy of Lifeart/Mediclip, Manual Medicine 1, Version 1.0a, Williams & Wilkins, 1997.



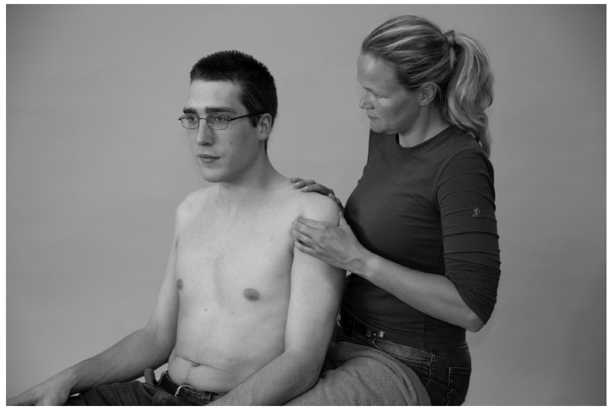


Fig. 3. Palpation technique for trigger point palpation of the infraspinatus muscle, anterior deltoid muscle, and the biceps brachii muscle, respectively.

characteristics for the three bilateral muscles within a 10-minute period. Subjects were examined in groups of three with each subject in a separate, private treatment room. Following the first assessment, the raters were randomly assigned to one of the two other rooms to assess another subject until all three raters had assessed all subjects. Upon completion of the assessment of the initial group of three subjects, three new subjects were assigned to the examination rooms and the procedures were repeated. An observer was present in each room during all examinations to verify correct implementation of the testing procedures, but the observer did not interfere with the examination. According to the observers, all examinations were performed in an appropriate manner.

Statistical Analysis

For the statistical analysis, we used the Statistical Package for the Social Sciences for Windows version 12.0.1 (SPSS Inc., Chicago, IL). Frequencies were calculated for the subject demographic information.

To express interrater reliability, we calculated both pair-wise percentages of agreement (PA) and pair-wise Cohen Kappa-values (κ). The PA-value is defined as the ratio of the number of agreements to the total number of ratings made[36]. Using the terminology from the contingency matrix provided in Table 2, $PA = (a+d)/n$. Cohen's κ is a coefficient of agreement beyond chance: $\kappa = (PA - Pe)/(1 - Pe)$. The agreement based on chance alone (Pe) is calculated by the sum of the multiplied marginal totals corresponding to each cell divided by the square of the total number of cases (n): $Pe = (f1g1 + f2g2) / n^2$.

The κ-value is widely used for dichotomous variables in interrater reliability studies, although there is no universally accepted value for good agreement[37]. Landis and Koch[38] proposed that a κ-value < 0.00 be considered indicative of poor reliability and a value of 0.001–0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial or good, and 0.81–1.00 almost perfect or very good reliability. In this study, we considered a PA-value $\geq 70\%$ indicative of interrater reliability acceptable for clinical use, because under ideal circumstances, i.e., equal prevalence of negative and positive findings, when using a dichotomous test, a PA-value $\geq 70\%$ leads to a $\kappa \geq 0.40$.

A major drawback to using κ as an index of agreement is that this statistic is very sensitive to the prevalence of positive and negative findings. To quantify this effect on the κ-values calculated, in this study we also determined the prevalence index (Pi), which is the absolute value of the difference between the number of agreements on positive findings (a)

TABLE 2. The contingency matrix

		Rater 1		
		Positive	Negative	
Rater 2	Positive	a	b	g_1
	Negative	c	d	g_2
Total		f_1	f_2	n

and agreements on negative findings (d) divided by the total number of observations (n): Pi = | $a - d$ | / n [39]. If Pi is high (closer to 1), chance agreement (Pe) is also high and κ is reduced accordingly. If the Pi is closer to 0, chance agreement (Pe) is low and κ will increase. This means that the κ-statistic is more useful as an index of agreement in case of a low Pi than it is with higher Pi-values. Table 3 provides examples of the influence of variations in Pi on κ-values. With κ-values in this study strongly influenced by variations in prevalence as indicated by the wide range of Pi, we were forced to focus on the PA-values for the interpretation of our findings.

TABLE 3a. Example of the influence of a high value of the prevalence index on the κ value (Example used: Trigger point 3, right shoulder, couple A/C, palpation of a nodule)

		Observer 1		
		Positive	Negative	
Observer 2	Positive	35	2	37
	Negative	2	1	3
Total		37	3	40

In this case, the percentage of agreement is high (0.90), but because the prevalence index is also high (0.85), the κ-value indicates only fair agreement (0.28).

TABLE 3b. Example of the influence of a low value of the prevalence index on the κ value (Example used: Trigger point 2, right shoulder, couple B/C, palpation of a nodule)

		Observer 1		
		Positive	Negative	
Observer 2	Positive	19	0	19
	Negative	5	16	21
Total		24	16	40

In this case the percentage of agreement is high (0.85), but the prevalence index is low (0.08), so despite slightly lower percentage agreement than in Table 3a, the κ-value (0.75) indicates good agreement.

To compare the three pairs of raters, we used the Kruskal-Wallis test, which is a non-parametric one-way analysis of variance. The test statistic H will increase with increased variation. For graphical presentation, we used the box-and-whisker plot. To compare several data sets, this semi-graphical way of summarizing data, which provides median value, lower and upper quartiles, and the extreme values, is considered simple and useful[37].

Results

Patient Characteristics

Thirty-two subjects with unilateral or bilateral shoulder pain and eight subjects without shoulder pain were included in this study. The mean age of subjects was 40 (SD = 11.5; range 18 to 70). Of these 40 subjects, 24 (60%) were female and 16 (40%) were male. The study population had a gender and age profile similar to the patient population of the physical therapy practice where the study was conducted. Most of the subjects (53%) were not diagnosed with a specific medical diagnosis for their shoulder complaints as suggested in the guidelines developed by the Dutch Society of General Practitioners[5]. Table 4 provides physician referral diagnoses for the 32 patients involved in this study.

Pair-Wise Interrater Agreement

Tables 5 to 8 present the data of the various clinical characteristics of the MTrP in the 80 shoulders of our 40 subjects, i.e., palpable nodule in a taut band, referred pain sensation, LTR, and the jump sign, respectively. The column PA provides the percentage agreement values for the three pairs of observers for both the left and right shoulder. The column κ shows the corresponding κ-value; the third column shows the corresponding prevalence index (Pi).

Although we have insufficient information to calculate mean agreement values for all rater pairs, we can cautiously conclude that the rater pairs seemed to be demonstrating similar reliability. When comparing the pair-wise PA-values for the presence or absence of MTrPs, we found no significant difference between the rater pairs (Kruskal-Wallis one-way ANOVA on ranks, H=0.841, P > 0.05; Figure 4).

Palpable Nodule in a Taut Band

The PA-value for the palpable nodule in a taut band in the muscle varied from 45% in the medial head of the biceps brachii muscle to 90% in the infraspinatus muscle. The PA tended to be higher in trigger point 3 (83%–90%) than in point 1 (63%–73%). In the anterior deltoid muscle the PA varied from 63% to 75%. The PA for the biceps brachii varied from 45% to 75%. Only the rater pair A/C agreed in both points more than 70%. The κ varied from 0.11 to 0.75 (Table 5).

Referred Pain Sensation

The agreement on the referred pain sensation elicited by pressure on the nodule reached a PA-value ≥ 70% in all but 3 cases (range 63%—93%). The scores for referred pain sensation were the lowest in the infraspinatus (trigger point 1). The κ-value varied from –0.13 to 0.64 (Table 6).

Local Twitch Response

The LTR had only acceptable agreement for two locations in the infraspinatus. The lowest PA was 33% in trigger point 3, which is the most central point in the infraspinatus muscle. All three raters were unable to elicit an LTR in trigger point

TABLE 4. Patient diagnosis and referral information

Referral diagnosis	Number of subjects	Percentage
No medical diagnosis. The physician referred the patient to the practice without mentioning any medical diagnosis. This follows to the Dutch guidelines for general practioners.	17	53%
Calcifying tendonitis	2	6%
Tendonitis / bursitis / tendinosis	3	9%
Soft tissue disorder	7	22%
Degenerative changes in the acromioclavicular or glenohumeral joint	2	6%
Subacromial impingement syndrome	1	3%
Total	32	100%

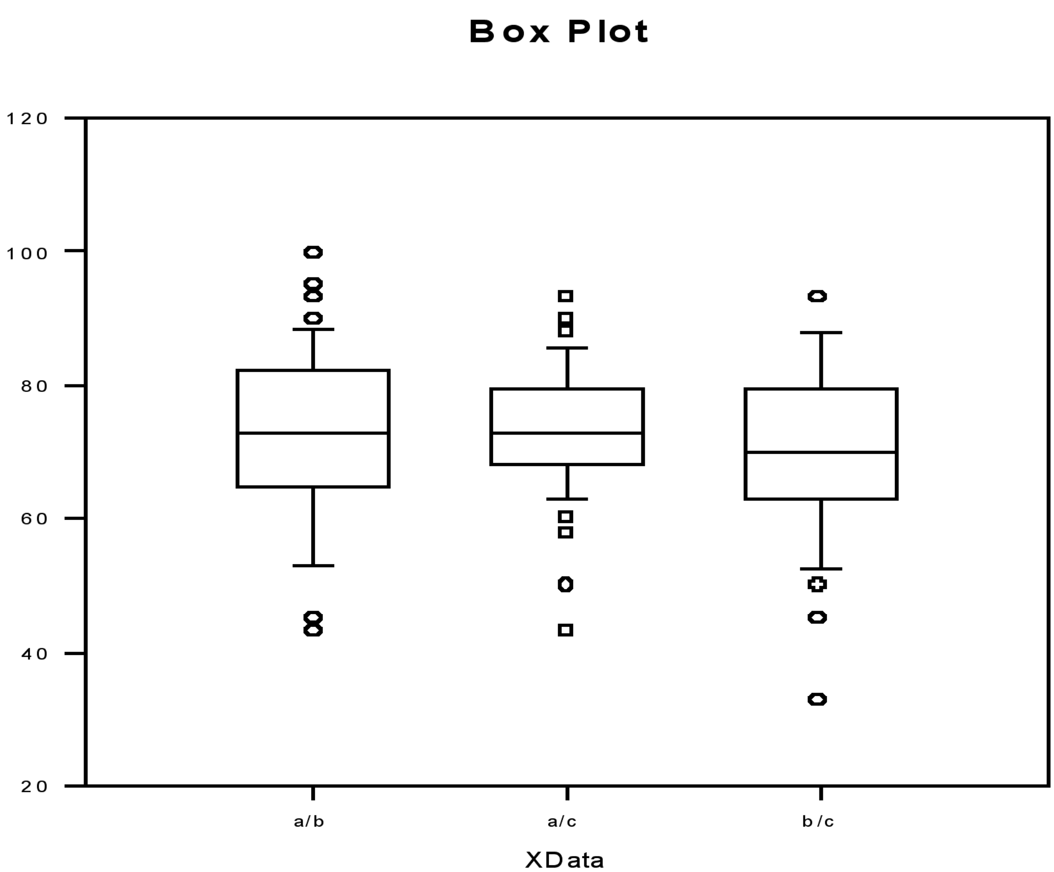


Fig. 4. This box-n-whisker plot shows the graphical expression [i.e., median, lower and upper quartile, minimum and the maximum value] of the dataset from the pairs of raters. This graphic shows only small differences (not statistically or clinically relevant differences) between the three pairs of observers.

TABLE 5. Percentage of agreement (PA), kappa coefficient (κ), and the prevalence index (Pind) calculated for palpation of a nodule in a taut band in 6 localizations in 3 muscles (left and right).

The numbers 1, 2, and 3 in the first column correspond with the localization in the infraspinatus muscle, 4 is localized in the anterior deltoid muscle, and 5 and 6 are localized in the biceps brachii muscle. In the second row, the three raters are mentioned as A, B, and C. The number of subjects is 40.

		Rater pairs								
		A/B			A/C			B/C		
TrP	**Side**	**PA%**	**κ**	**P*ind***	**PA%**	**κ**	**P*ind***	**PA%**	**κ**	**P*ind***
1	Left	65	0.22	0.40	68	0.30	0.38	68	0.34	0.13
	Right	73	0.40	0.32	63	0.24	0.13	70	0.47	0.30
2	Left	70	0.35	0.30	80	0.60	0.10	65	0.30	0.20
	Right	73	0.44	0.18	70	0.43	0.05	88	0.75	0.08
3	Left	83	0.26	0.73	90	0.30	0.85	88	0.25	0.83
	Right	85	0.33	0.75	90	0.28	0.85	85	0.33	0.75
4	Left	63	0.34	0.03	70	0.40	0.20	63	0.25	0.18
	Right	75	0.50	0.15	63	0.26	0.13	68	0.35	0.03
5	Left	45	0.16	0.00	68	0.27	0.38	53	0.14	0.18
	Right	53	0.16	0.13	80	0.58	0.20	53	0.11	0.18
6	Left	53	0.22	0.03	73	0.25	0.53	45	0.15	0.05
	Right	53	0.22	0.03	75	0.44	0.35	58	0.24	0.13

2 (also in the infraspinatus muscle) in almost any of the subjects. This led to an agreement of 100% in one case; in most cases it was not possible to calculate a κ-value because of the absence of the LTR in all cases of one rater (Table 7).

Jump Sign

The raters achieved the highest PA (93%) on the jump sign in the infraspinatus muscle and the lowest PA (63%) in the infraspinatus muscle and the biceps brachii muscle. The κ varied from 0.07 to 0.68 (Table 8).

Overall agreement

The percentage of agreement on MTrP presence or absence was acceptable for the infraspinatus muscle. In two out of three trigger point locations, PA-values exceeded 70%. In the anterior deltoid muscle and in the biceps brachii muscle, the PA-value was < 70% (Table 9).

Discussion

Palpation is the only method available for the clinical diagnosis of myofascial pain. Therefore, reliable MTrP palpation is the necessary prerequisite to considering myofascial pain as a valid diagnosis. This study indicated that referred pain was the most reliable criterion for palpatory diagnosis in all six MTrPs in all three muscles on both sides. Only in three of the 36 MTrP locations did the PA-value not reach the predetermined value of 70%. This finding is consistent with the results of other interrater reliability studies of MTrP examination[26,27]. The nodule in the taut band, the LTR, and the jump sign were more reliable in the infraspinatus muscle than in the anterior deltoid and biceps brachii muscle. In general, the jump sign also proved a reliable palpatory characteristic in this study. This is in contrast to other studies, which may indicate that the raters in this study were more successful in standardizing the amount of pressure during the palpation. In general, the LTR was not a reliable characteristic although it did prove reliable for MTrP 1 and 2 in the infraspinatus on either side. Palpation of the nodule in the taut band had sufficient reliability for the diagnosis of MTrPs in the infraspinatus muscle, but less for diagnosis of MTrPs in the anterior deltoid and biceps brachii muscles. There was also a high level of agreement for the presence or absence of MTrPs in the infraspinatus muscle. This agreement was lower for the anterior deltoid and biceps brachii muscles.

Compared to various other commonly used physical examination tests such as the assessment of intervertebral motion or muscle strength, whose established interrater relia-

TABLE 6. Percentage of agreement (PA), kappa coefficient (κ), and the prevalence index (P*ind*) calculated for palpation of referred pain in 6 localizations in 3 muscles (left and right).

		Rater pairs								
		A/B			A/C			B/C		
TrP	Side	PA%	κ	P*ind*	PA%	κ	P*ind*	PA%	κ	P*ind*
1	Left	78	0.48	0.38	63	0.19	0.28	65	0.21	0.35
	Right	78	0.51	0.33	75	0.41	0.40	73	0.41	0.28
2	Left	88	0.38	0.78	88	0.55	0.68	80	0.23	0.70
	Right	80	0.25	0.70	85	0.33	0.75	85	0.53	0.6
3	Left	73	0.46	0.08	63	0.26	0.13	70	0.36	0.25
	Right	83	0.64	0.18	78	0.54	0.13	80	0.58	0.2
4	Left	78	0.13-	0.78	85	0.31	0.75	78	0.13-	0.78
	Right	88	0.55	0.68	80	0.25	0.70	88	0.22	0.83
5	Left	93	0.36	0.88	83	0.29	0.73	80	0.13	0.75
	Right	85	0.19	0.80	93	0.63	0.78	88	0.06-	0.88
6	Left	90	0.45	0.80	75	0.25	0.60	70	0.03	0.65
	Right	88	0.38	0.78	75	0.15	0.65	78	0.20	0.68

TABLE 7. Percentage of agreement (PA), kappa coefficient (κ), and the prevalence index (Pind) calculated for palpation of a local twitch response in 6 localizations in 3 muscles (left and right).

		Rater pairs								
		A/B			A/C			B/C		
TrP	Side	PA%	κ	P*ind*	PA%	κ	P*ind*	PA%	κ	P*ind*
1	Left	80	0.09	0.75	73	0.21	0.58	78	0.36	0.58
	Right	85	0.04-	0.85	75	0.05-	0.75	75	0.15	0.65
2	Left	100	n.c	1.00	73	n.c.	0.73	73	n.c.	0.73
	Right	95	n.c.	0.95	78	n.c.	0.78	78	0.11	0.73
3	Left	53	0.05	0.13	58	0.15	0.38	50	0.16	0.25
	Right	70	0.15	0.55	43	0.13	0.13	33	0.07	0.03
4	Left	73	0.04	0.68	63	0.14	0.38	65	0.11	0.55
	Right	65	0.21	0.35	60	0.20	0.20	60	0.20	0.15
5	Left	43	0.00	0.28	50	0.04	0.00	58	0.00	0.48
	Right	53	0.01	0.43	73	0.45	0.08	60	0.13	0.45
6	Left	53	0.17	0.28	68	0.32	0.28	50	0.16	0.25
	Right	60	0.23	0.35	63	0.25	0.08	58	0.21	0.33

n.c. = not calculated

TABLE 8. Percentage of agreement (PA), kappa coefficient (κ), and the prevalence index (Pind) calculated for palpation of the jump sign in 6 localizations in 3 muscles (left and right).

		Rater pairs								
		A/B			A/C			B/C		
TrP	Side	PA%	κ	P*ind*	PA%	κ	P*ind*	PA%	κ	P*ind*
1	Left	75	0.47	0.25	83	0.60	0.38	78	0.51	0.33
	Right	63	0.27	0.18	73	0.36	0.38	65	0.31	0.15
2	Left	70	0.07	0.60	68	0.12	0.53	88	0.68	0.53
	Right	68	0.02	0.63	75	0.19	0.65	93	0.58	0.43
3	Left	70	0.29	0.40	68	0.22	0.43	78	0.38	0.53
	Right	75	0.47	0.25	75	0.49	0.15	80	0.58	0.25
4	Left	78	0.56	0.18	65	0.31	0.15	73	0.36	0.38
	Right	78	0.54	0.18	78	0.48	0.43	70	0.34	0.40
5	Left	68	0.30	0.33	68	0.33	0.18	65	0.22	0.35
	Right	68	0.31	0.28	68	0.31	0.28	65	0.16	0.4
6	Left	68	0.35	0.28	70	0.40	0.05	63	0.28	0.18
	Right	70	0.37	0.25	83	0.64	0.18	73	0.41	0.28

bility ranges from 41% to 97%[40-43], the interrater agreement with regard to MTrP palpation in these three shoulder muscles seemed acceptable. However, the degree of agreement seemed to be strongly dependent on the muscle that was examined. Clinical experience suggests that some muscles are more accessible to palpation than others. There may even be differences within particular muscles. For trigger point 3 of the infraspinatus muscle, the raters achieved the highest agreement. Because MTrPs are often in close proximity to each other, raters did not always agree on which MTrP they were evaluating. For example, the raters may have had difficulty in distinguishing trigger points in the infraspinatus muscle, the teres minor muscle, and the posterior deltoid muscle. The area of referred pain may help in determining which muscle was palpated. However, recognition of pain elicited by palpation, as normally would occur in the clinical situation, was not determined in this study, as this could have endangered the blinding of the raters. Recognition of this characteristic pain by the patient may be an important aspect of reliable MTrP identification. For the biceps brachii muscle, the raters may have had difficulty distinguishing between the lateral and the medial head of the muscle. It is conceivable that such difficulties could contribute to the lower level of agreement noted for this muscle.

We realize that by collapsing rating categories in this study to *absent or present* and by not including a third category of indeterminate findings, we may have artificially inflated reliability findings. We decided to score dichotomously for the presence or absence of MTrPs and not include this indeterminate category because the treatment choice would have been similar independent of a negative or indeterminate finding. When MTrPs are absent or when the physical therapist is unsure about the presence or absence of an MTrP, in the clinical situation no treatment will be directed to the MTrP.

We should again note that in this study no distinction was made between active and latent MTrPs, as the examiners were not allowed to inquire whether subjects recognized the pain from palpation. Therefore, examiners may have reported on both active and latent MTrPs in symptomatic and asymptomatic subjects. This may affect external validity in this study in that its findings cannot be directly extrapolated to the clinical situation where patient report of recognition of pain is available and the distinction between active and latent trigger points, therefore, can be made.

In the interpretation of the study findings, we chose to emphasize PA over κ-values. PA-values do not take into account the agreement that would be expected purely by chance. True agreement is the agreement beyond this expected agreement by chance, and κ is a measure of true, chance-corrected agreement. However, as we earlier mentioned, the κ-statistic is probably inappropriate for studies in which the positive and negative findings are not equally distributed[39,44-46]. In this study, even asymptomatic subjects had some (obviously latent) trigger points in the shoulder muscles. Subjects with unilateral shoulder pain often also may have latent or active trigger points in the contralateral shoulder[47,48]. Both may have contributed to the high prevalence of positive findings in this study. The resultant P*i* resulted in

TABLE 9. Percentage of agreement, kappa [κ] coefficient, and the prevalence index for agreement on presence or absence of myofascial trigger points

	Raters	PA%	κ	P*ind*
1 Left	A-B	75	0.50	0.05
	A-C	70	0.40	0.05
	B-C	70	0.40	0.05
1 Right	A-B	65	0.33	0.00
	A-C	65	0.29	0.15
	B-C	70	0.41	0.05
2 Left	A-B	78	0.38	0.53
	A-C	75	0.44	0.35
	B-C	73	0.38	0.38
2 Right	A-B	70	0.19	0.55
	A-C	73	0.29	0.53
	B-C	88	0.72	0.33
Left	A-B	73	0.18	0.58
	A-C	80	0.25	0.70
	B-C	83	0.29	0.73
3 Right	A-B	73	0.30	0.48
	A-C	78	0.40	0.53
	B-C	85	0.48	0.65
4 Left	A-B	63	0.31	0.13
	A-C	58	0.18	0.03
	B-C	65	0.25	0.30
4 Right	A-B	80	0.60	0.00
	A-C	68	0.35	0.03
	B-C	63	0.25	0.08
5 Left	A-B	53	0.22	0.13
	A-C	60	0.19	0.20
	B-C	58	0.18	0.28
5 Right	A-B	58	0.15	0.28
	A-C	73	0.45	0.03
	B-C	55	0.12	0.25
6 Left	A-B	58	0.28	0.08
	A-C	73	0.33	0.43
	B-C	50	0.20	0.00
6 Right	A-B	60	0.27	0.15
	A-C	80	0.58	0.20
	B-C	60	0.27	0.15

The numbers 1, 2, and 3 correspond with the localization in the infraspinatus muscle, 4 is localized in the anterior deltoid muscle, and 5 and 6 are localized in the biceps brachii muscle.

PA= Percentage of Agreement, κ = kappa coefficient, and P*ind* = prevalence index.

generally low κ-values despite high PA-values, making the κ-statistic less appropriate for the statistical representation and subsequent interpretation of study findings.

Training would seem important to achieve sufficient agreement, even when raters have considerable clinical experience. Prior to conducting this interrater reliability study, consensus about the standardization of manual palpation of MTrPs was achieved between raters. In this study, there was no statistically significant difference between the rater pairs, even though one rater had only two years of clinical experience with MTrP diagnosis and management. We recognize that this consensus training may impact external validity in that the results of this study may not apply to situations and clinicians where such training has not occurred. Future studies are needed to determine how many years of experience and what extent of pre-study consensus training is needed to achieve sufficient interrater reliability.

Conclusion

In this study, three blinded raters were able to reach acceptable pair-wise interrater agreement on the presence or absence of TrPs as described by Simons et al[31]. Referred pain was the most reliable feature in all six MTrPs in all three shoulder muscles on both sides. The nodule in the taut band, the LTR, and the jump sign were more reliable in the infraspinatus muscle than in the anterior deltoid and biceps muscle.

The results of this study support the idea that experienced raters can obtain acceptable agreement when diagnosing MTrPs by palpation in the three shoulder muscles studied. Allowing for patient report of pain recognition may provide for even better interrater reliability results. Interrater agreement seems dependent on the muscle and even on the location of the trigger point within a muscle, and findings indicating acceptable interrater reliability cannot be generalized to all shoulder muscles. The distinction between active and latent trigger points should be considered in future studies as should the effect of pre-study consensus training and clinical experience. However, in summary we conclude that this study provides preliminary evidence that MTrP palpation is a reliable and, therefore, potentially useful diagnostic tool in the diagnosis of myofascial pain in patients with non-traumatic shoulder pain.

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